CalDet Update: Overview and Light Injection

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At Caltech

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CalDet Overview and Light Injection

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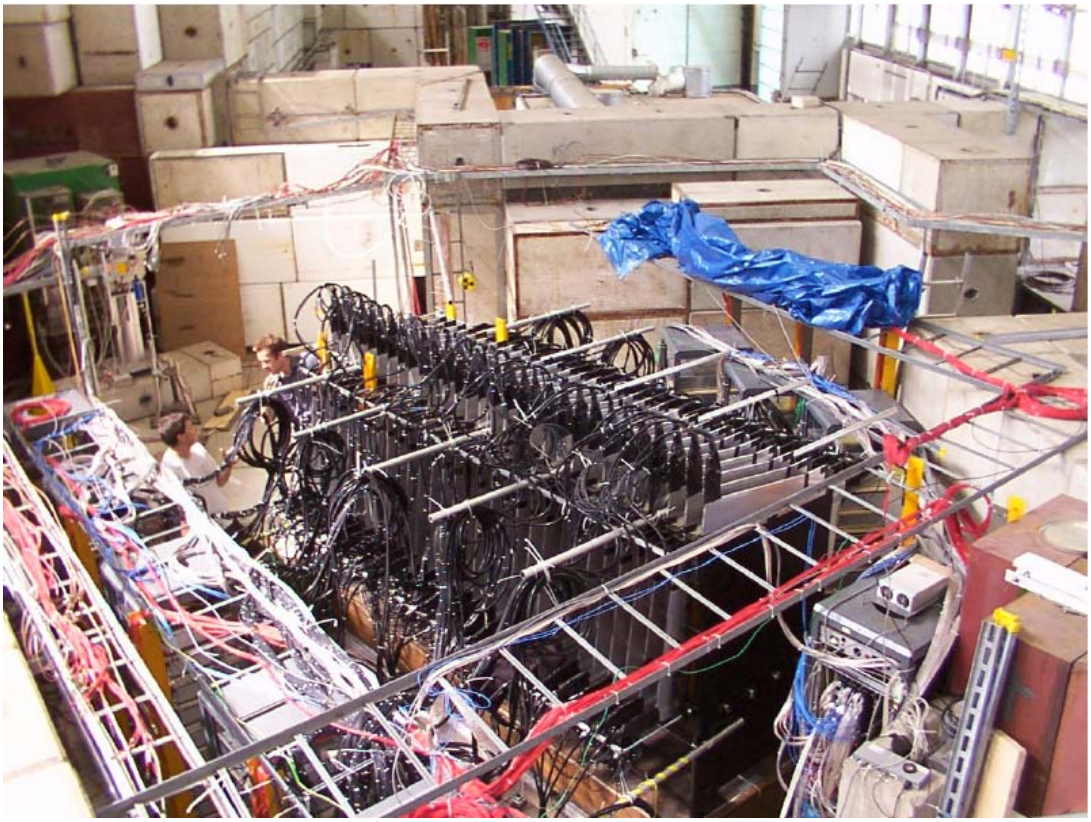
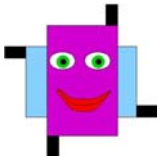
- Overview
- Linearity
- Stability
- Gain
- Uniformity





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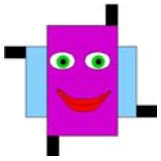
Overview

- The Calibration Detector was bulit and ran at CERN this summer.
- The CalDet has 60 planes, each 1m^2, read out with Far Detector electronics.
- It was built in a holding area outside the test beam.
  - Lots of debugging work was done before the test beam.
  - Beam related muons in the holding area helped the debugging.
- The detector has been disassembled, moved and rebulit twice.
- Ran in the T11 test beam for 8 weeks of the summer.
  - Running at energies from 0.5 - 3.5 GeV.
  - Took data at all these energies:
    * 0.5, 1, 1.2, 1.4, 1.6, 1.8, 2.0, 2.4, 2.8, 3.0 and 3.5GeV



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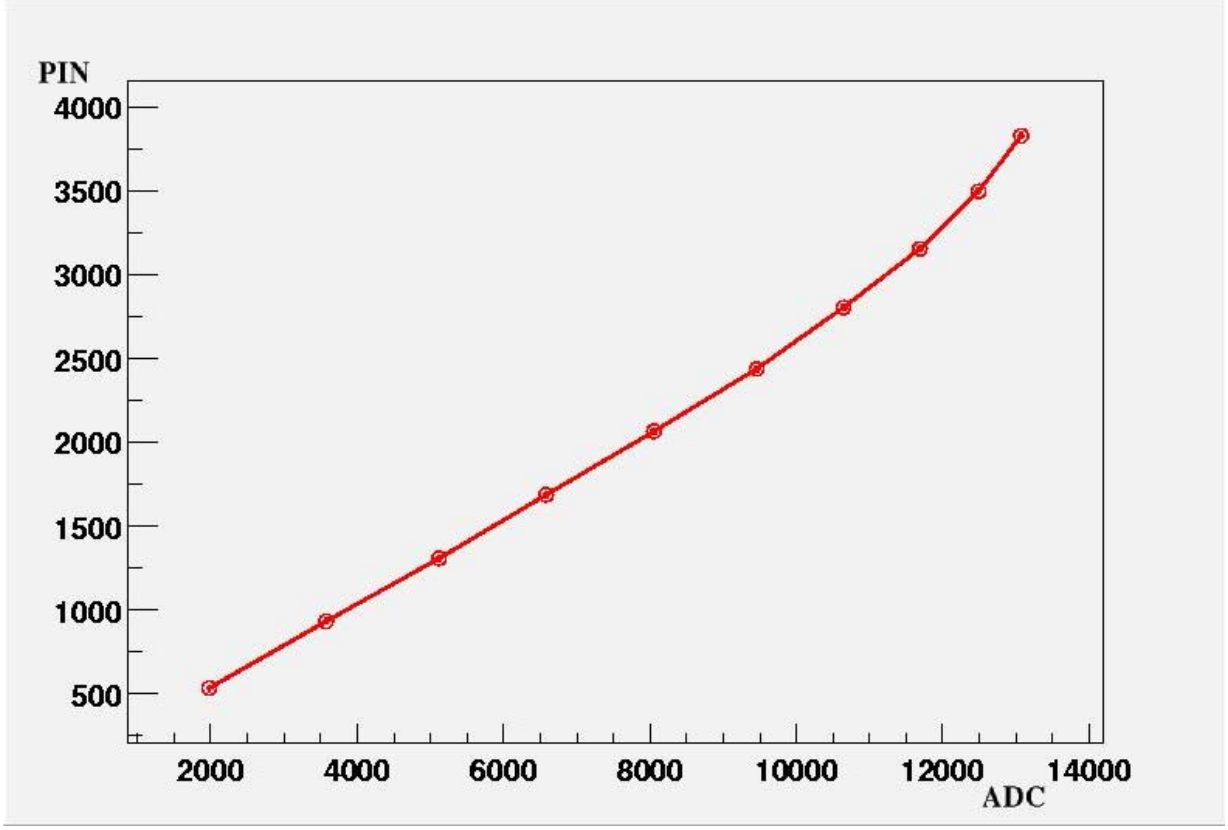
Overview - Part II

- We made lots of measurements over the summer with CalDet.
  - Some of which we will talk about today.
- We studied the trigger efficiency....
  - ....this was possible as null trigger data was taken due to the high singles rate.
- We obtained at the muon de/dx for calibration....
  - ....and also looked at the muon timing.
- Select hadrons using the TOF system....
  - ....there were 3 TOF paddles, with a maximum separation of 11m.
- We investigated the electrons in the beam....
  - ....using the Cerenkov counter to tag the electrons.
- Have started looking at how the data will be used...
  - ....and what measurements can be made with the data.
- The overall aim of the CalDet is the calibration of the Far and Near detectors.....
  - ....so I will start off by talking about the light injection calibration system and it's performance.

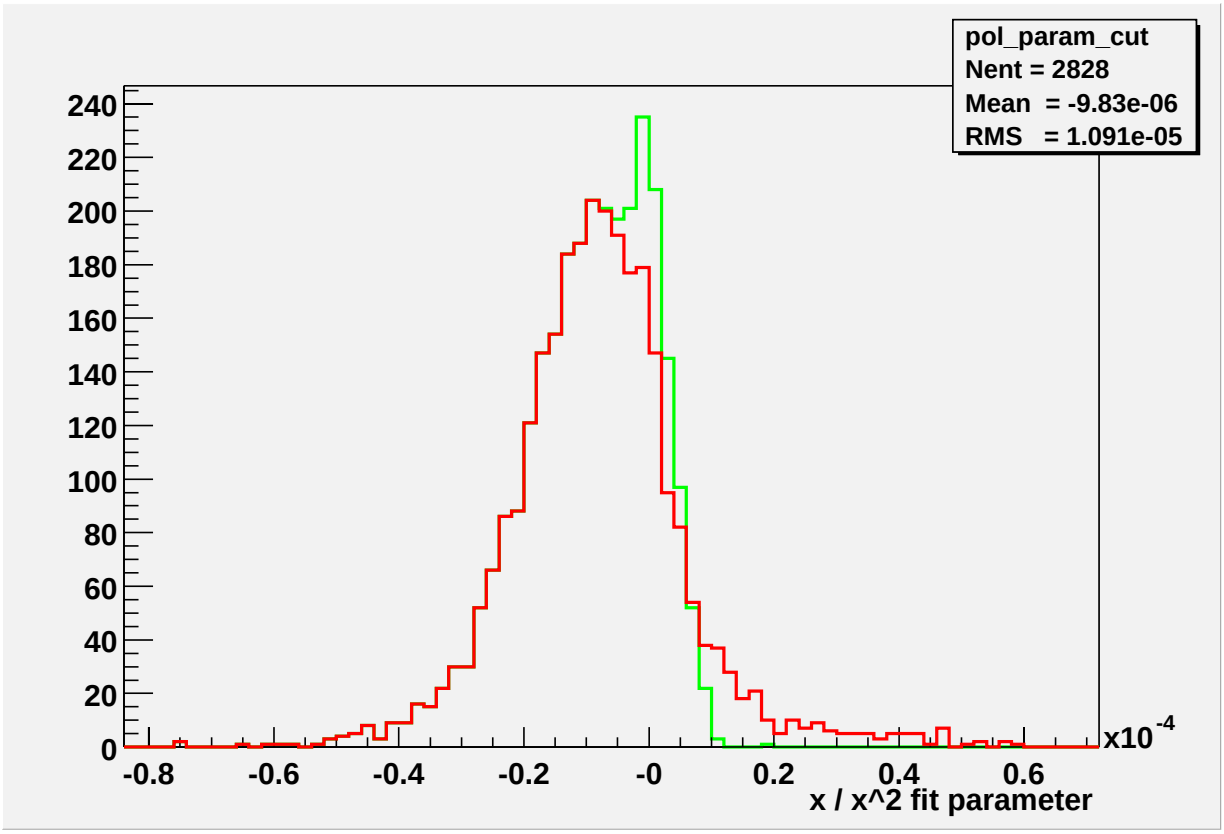
Linearity

- Took several linearity runs over the summer.
  - Each led is flashed a 1000 times at 10 different heights.
  - Use PIN diode as independent light level monitor.
  - Obtain a gain curve for each of the channels in the detector.
- An example gain curve is shown below.



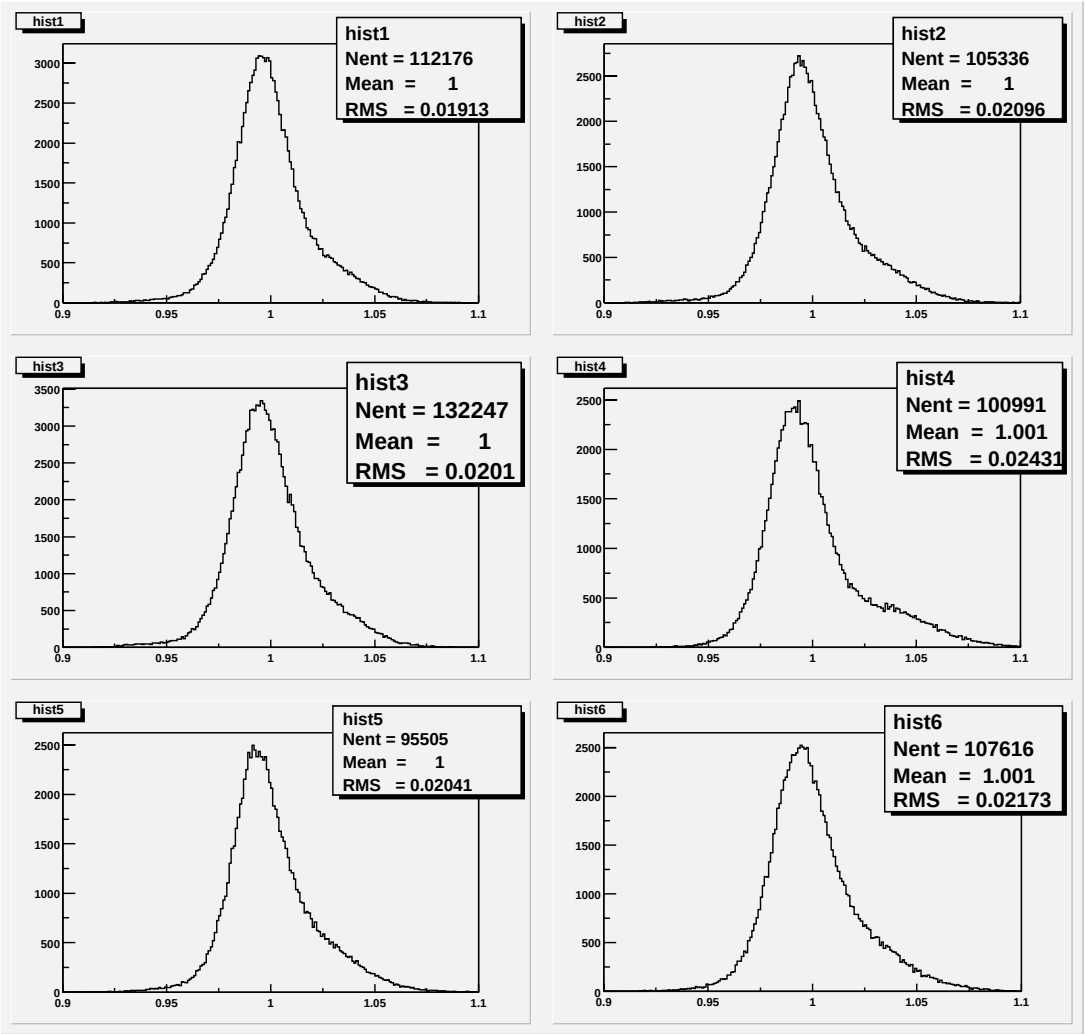
Linearity II

- There are a variety of ways to fit these curves.
  - Simplest is a straight line.
  - But is generally very good.
- If quadratic is fitted can get measure of non-linearity.
  - Take ratio of x2 over x parameters.
- The green curve is for truncated fit upto 10000 ADCs.



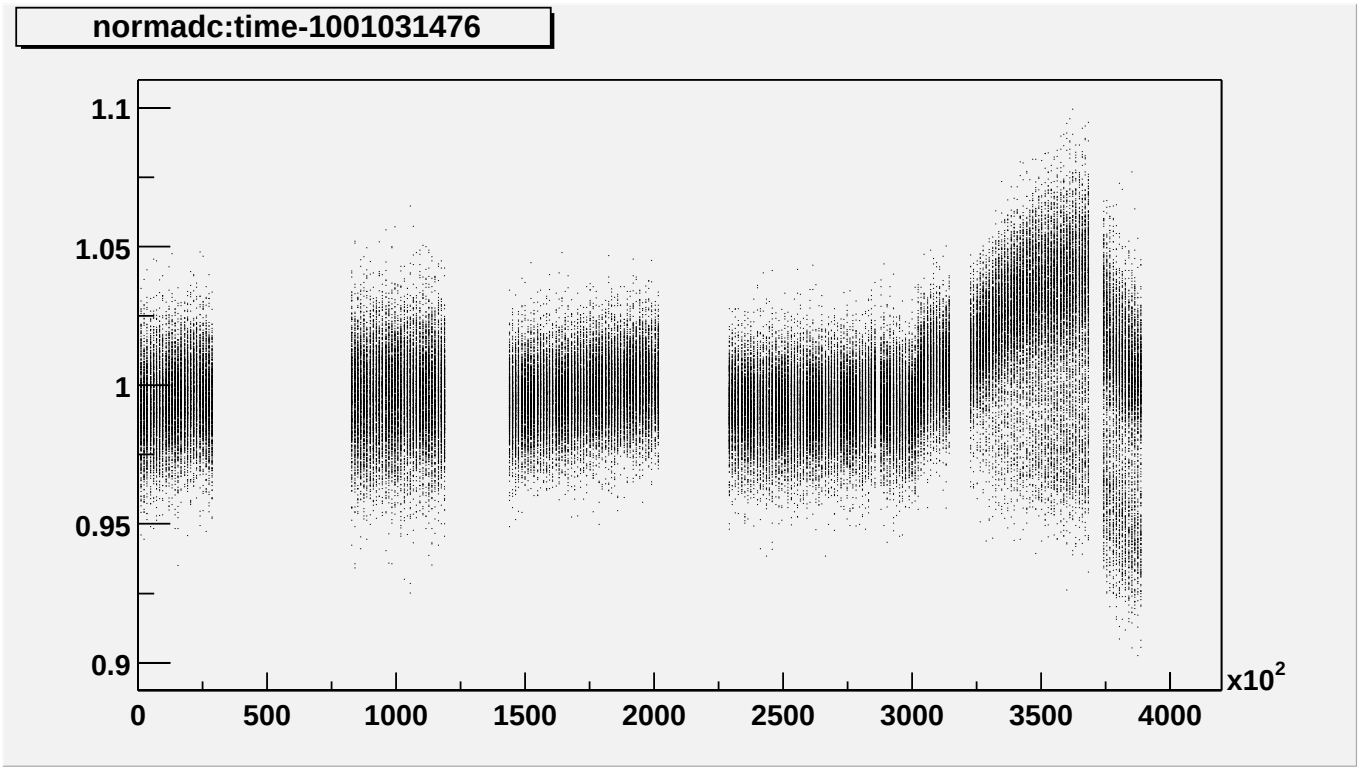
Stability

- Every 20 mins take stability point.
  - Each led is flashed 1000 times at the same height.
- Can use these ponits to measure the stability of:
  - Light injection system.
  - Cables and readout chain.
- Stability for each led is shown below, stable to 2% over 4 days.



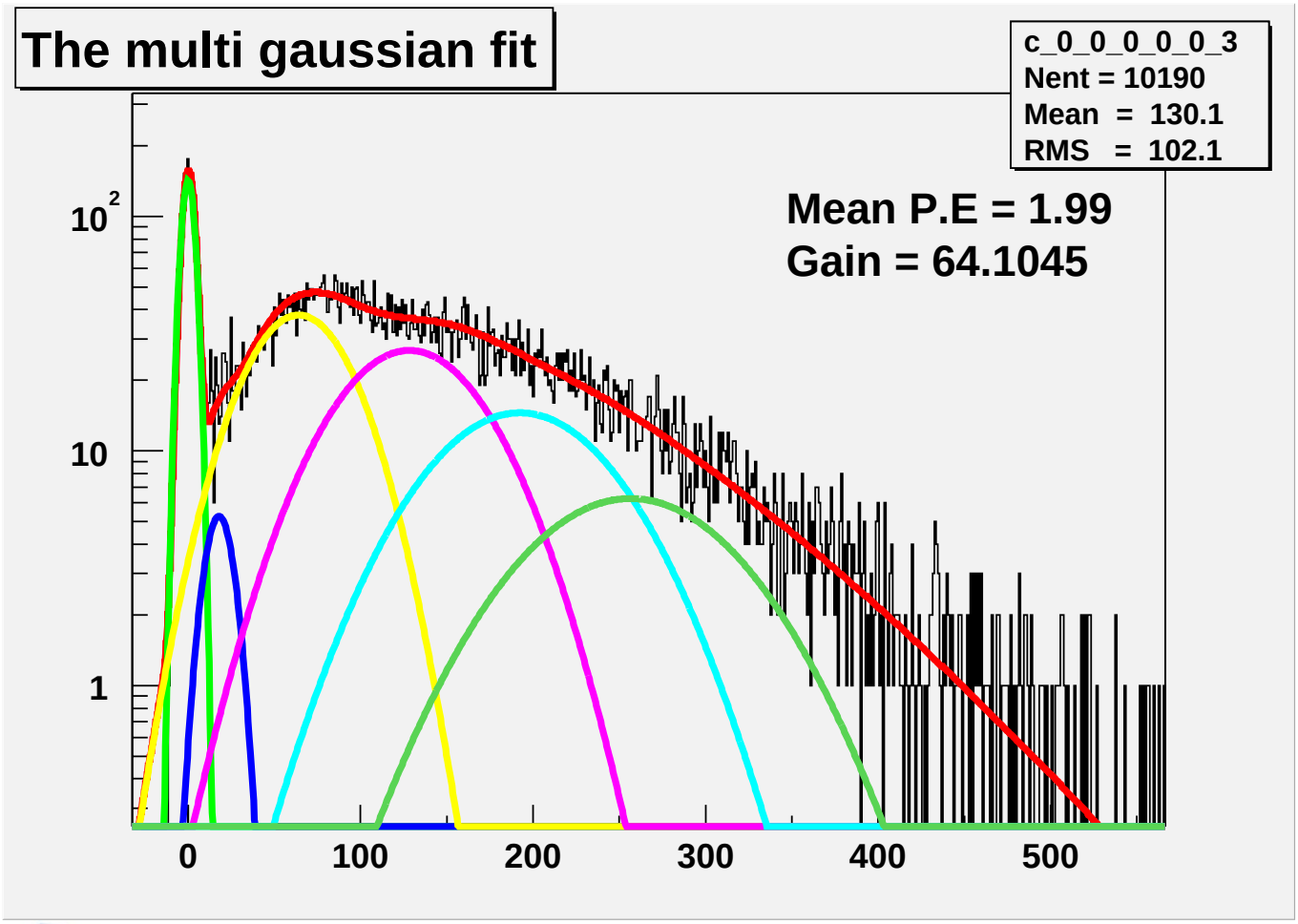
Stability II

- Whilst the overall stability of the system is 2% there are fluctuations.
- These are mainly run to run fluctuations, possibly caused by:
  - Temperature fluctuations.
  - High voltage fluctuations.
  - ..... something else.
- Stability points for led 1 are shown against time below.



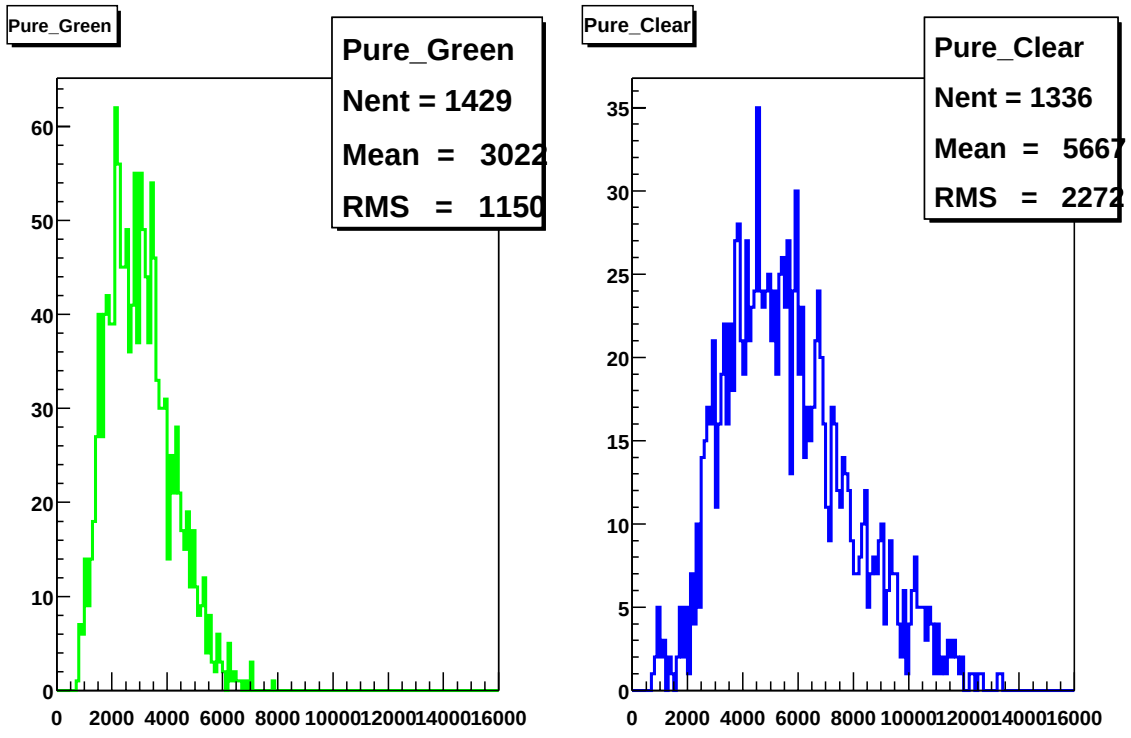
Gain

- Can also use the LI system to determine the number of ADCs per photo-electron.
  - This was done for each of the channels in the detector.
- There were two methods used to calculate the gain:
  - Fitting a multi-gaussian fit to low light level spectra.
  - The mean over sigma method for medium to high light levels.
- An example of the fit method is shown below.



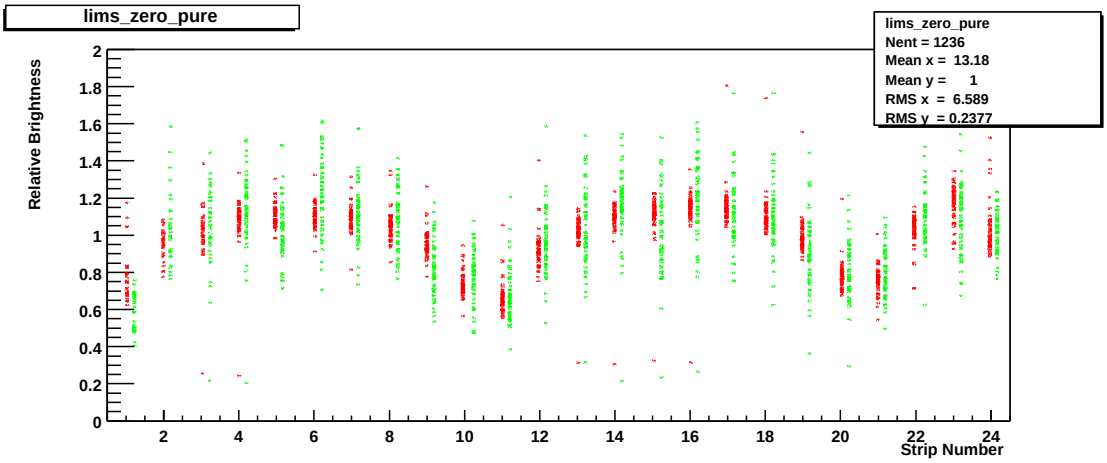
Uniformity

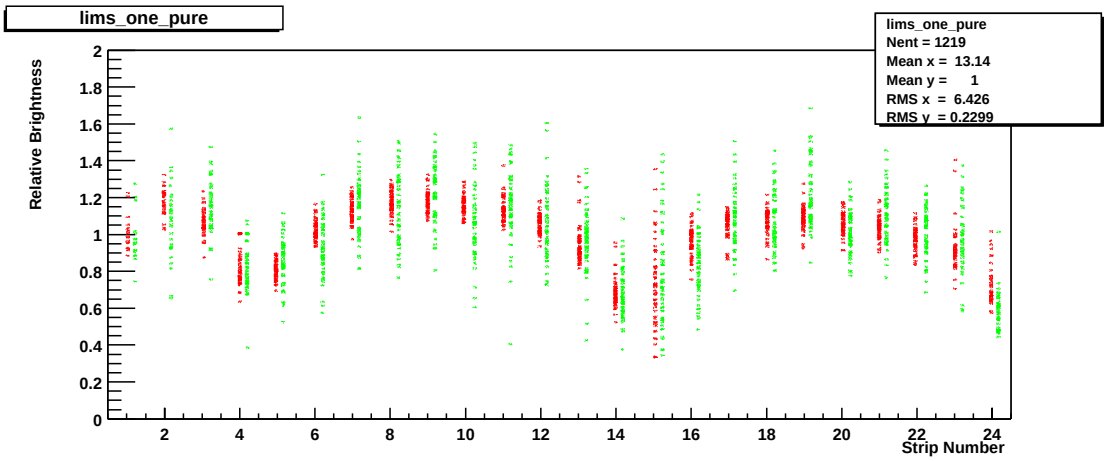
- There are a number of factors which contribute to the uniformity of the LI system, including:
  - The leds and internal pulser box wiring.
  - The fibres from the pulser box to the LIMs.
  - The Light injection manifolds, LIMs.
  - The detector's green fibre.
  - The readout cables and connections.
  - The PMTs and electronics.
- From raw data find:
  - For green readout cables: 38% width.
  - For clear readout cables: 40% width.

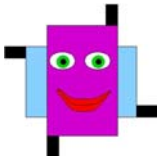


Uniformity II

- Most of these factors can be accounted for:
  - The PMTs and electronics by the Gain.
  - The readout cables and connections using Muon's.
  - The pulser box and LI fibres were tested.
- The main factor left is the LIM non uniformity, see plot below.
  - Due to a painting problem that has been identified.
- Still concerns over dynamic range.







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Summary

- Have taken lots of light injection data.
  - Both linearity curves and stability points.
- The overall stability of 2% is very good.
- Have determined the gain for all working channels.
- The uniformity isalmost understood.
- Still a question over whether we need to exercise the full dynamic range of the electronics.